BE-WoodEN - Buildings and Education in Wood Ecosystem
for the New European Bauhaus

D4.4
Report about Innovation Lab on the use of wood for buildings in Slovenia

WP4/Task T4.3

Co-funded by the European Union

New European Bauhaus
beautiful | sustainable | together

Partners

Università di Genova | DAD DIPARTIMENTO ARCHITETTURA E DESIGN

REGIONE LIGURIA

ART-ER ATTRATTIVITÀ RICERCA TERRITORIO

UNIVERSITÀ DEGLI STUDI FIRENZE DAGRI

FLA FEDERLEGNOARREDO

HOUSING EUROPE

UNIVERZA NA PRIMORSKEM

Politechnika Wrocławska

Grant agreement	LIFE23-PRE-IT-LIFE-BE-WoodEN/101148077
Programme	LIFE
Project acronym	BE-WoodEN
Project title	**BE-WoodEN - Buildings and Education in Wood Ecosystem for the New European Bauhaus**
Project starting date	01/02/2024
Project end date	31/01/2026
Project duration	24 months
Project work package	WP4 - Innovation Lab
Deliverable title	Report about Innovation Lab on the use of wood for buildings in Slovenia
Nature of deliverable	Report
Dissemination level	[Public]
Due date of deliverable	31.03.2025
Actual date of deliverable	31.03.2025
Produced	University of Primorska
Reviewed	University of Genoa
Validated	University of Genoa

SUMMARY TABLE

1. Overview of Study visit

University of Primorska, in collaboration with the involved partners, organized an innovative workshop related to overcoming obstacles in the use of wood based products for construction at InnoRenew CoE, Izola (Slovenia). The agenda of the study visit was the following:

17.2.2025: Travel of participants to Izola
18.2.2025: Workshop at InnoRenew CoE, Livade 6a, Izola
- 9:00 – 9:15 Coffee at InnoRenew and welcome (Andreja Kutnar)
- 9:15 – 10:15 Specific of designing timber buildings (Eva Prelovšek Niemelä)
- 10:15 -11:15 Moisture control during service life (Jakub Sandak & Eva Prelovšek Niemelä)
- 11:15 -12:15 Wooden facades (Anna Sandak)
- 12:15-13:15 Engineered wood products for construction (Mohammad Derikvand)
- 13:15-14:00 Lunch with coffee
- 14:00-15:00 Tour of the laboratories and building (Jakub Sandak, Michael Burnard)
- 15:00-18:00 Free time
- 18:00-20:00 Dinner at Kamin, Belvedere

19.2.2025: Visit to Stilles
- 8:00 Departure of Izola
- 10:30-11:30 Visit of CLT production
- 13:00-14:00 Lunch
- 14:00 Departure to Italy

1.1 About InnoRenew CoE

InnoRenew CoE is a private not-for-profit research organization dedicated to advancing sustainable construction with renewable materials through high-quality science, collaboration with strategic partners in academia, industry, government, and society. This 5-year strategy document presents our current vision and goals, along with a future outlook for development of the organization.
InnoRenew CoE's vision is to be both a world leader in the interdisciplinary science of the built environment and a model for international research excellence, industrial collaboration, and public engagement.
InnoRenew CoE's mission is to advance the state of the art in nature-based solutions, especially using wood, that support and accelerate the adoption of regenerative sustainability through:

- Material and processing advances to optimise efficiency and generate knowledge,
- Engineered living materials to bring the function and capabilities of living organisms,
- Design solutions for health and sustainability based on Restorative Environmental and Ergonomic Design (REED).

The InnoRenew CoE institute operates in the largest wooden building in Slovenia (Figure 1). Design of the building had a complex task beyond the design of a functional building: demonstrate how the physical transformation of a place defined as post-industrial could bring new spirit and sociotechnical development by creating an engaging scientific hub. The project ambitiously brought new knowledge to local community and the nation.

The building consists of offices, meeting spaces, and laboratory facilities. There are eight laboratories where the properties of wood and other renewable materials are studied. The interior of the building was designed according to the principles of REED (Restorative Environmental and Ergonomic Design) a design paradigm developed by InnoRenew CoE researchers to guide designers on use of wood and other renewable materials in sustainable buildings to improve occupant wellbeing through exposure to nature, encouraging activity, and ergonomic design. A rainwater collector was used for flushing the toilets and watering the outdoor greenery. Solar collectors on the roof are used to heat sanitary water. The building has flat green roofs, realizing the regenerative principle of nature – that our building should be part of it.

The layout of rooms and interior fittings encourage movement during work. Materials were selected considering full sensory engagement: touch, appearance, smell, etc. Spaces were planned to create an environment that can reduce stress and encourage creativity and efficiency at work. A key factor in the design of the building was assessing its environmental impacts and taking responsibility for them. Following an LCA of the building, 3000 regionally appropriate trees were planted in the local municipality to offset its environmental impact.

Users are motivated to use sustainable and healthy means of movement throughout the building. They are motivated to the use of large wooden stairs instead of the elevator, to meet and interact with each other in the central atrium, and to arrive on foot or by bike. This represents a shift in building from minimizing environmental harm towards creating positive impacts for the natural environment, building users, and society in general.

Building has 1100 m3 of wood built into it. In the building were used natural materials, particularly massive wood for construction, local stone for the façade and outdoor arrangement, and various types of wood on the façade are reminiscent of local traditional material use (e.g., wood for shading, pergola structures). The building demonstrates the use of natural light, air quality control, acoustic elements,

open spaces for social interaction and physical movement, views through the building interior and to the outdoors, outdoor areas with particular microclimatic zones, green roofs, and terraces.
Project was selected as New European Bauhaus prize 2024 Finalist.

Figure 1: InnoRenew CoE building – exterior. Author: Miran Kambič

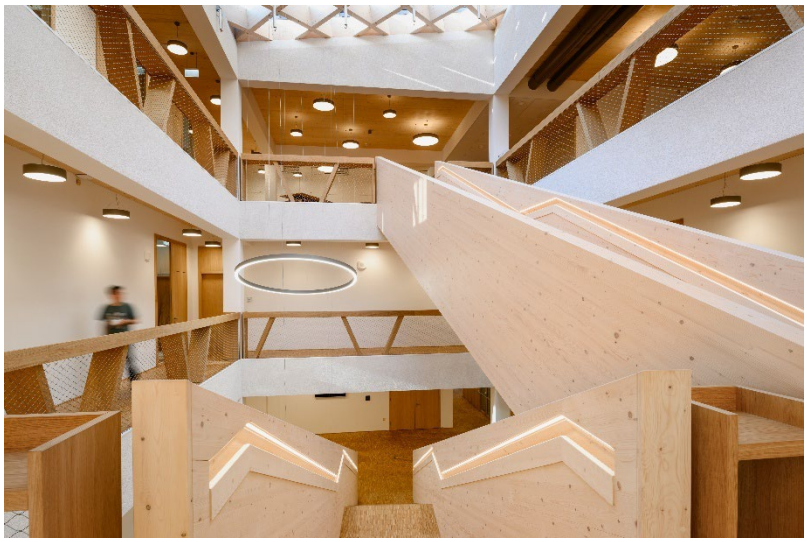

Figure 2: InnoRenew CoE building – interior. Author: Miran Kambič

1.2 About Stilles d.o.o.

Stilles boasts more than 75 years of tradition in hotel interior design, with references such as Marriott (Luxury Collection, W, Pharagraph, Sheraton, Ritz Carlton), Hyatt, Mandarin Oriental, Kempinski, Hilton, NH Hotels, Ascott (Citadines), IHG (Holiday Inn), Falkensteiner, H hotels and several other hotel franchises. The company has a total of 300 employees. More than 90% of their revenues are generated abroad. Main markets are Germany, Switzerland, Austria and Croatia.

In 2024 the company invested into production of Cross Laminated Timber (CLT). The Stilles d.o.o. operates a manufacturing plant located at Savska cesta 13, 8290 Sevnica, Slovenia in which CLT is manufactured in accordance with ETA 24/0182 issued by Austrian Institute of Construction Engineering in April 2024. Stilles CLT are made of softwood boards which are bonded together in order to form cross laminated timber (solid wood slab elements). Generally, adjacent layers of the softwood boards are arranged perpendicular to each other. Surfaces of the boards are planned. The solid wood slab elements consist of at least 3 and up to 9 adjacent layers which are arranged perpendicular to each other. With regard to the thickness of the solid wood slab element, thickness and orientation of individual layers are symmetrically assembled.

The production of CLT has detailed quality control measures and traceability of timber in the production. The quality goals of the Stilles are:

- to ensure that products consistently meet or exceed established quality standards and customer expectations by the established quality management system;
- to ensure that the materials entering the manufacturing process meet quality standards and specifications by carefully selecting suppliers and the management of raw material;
- to perform process control and validation by establishing and maintaining control over production processes to consistently produce products that meet quality specifications;
- to perform quality testing and inspection - systematic examination and testing of products to verify that they meet established quality standards and specifications.

1.3 About lecturers

Eva Prelovšek Niemelä

Eva Prelovšek Niemelä is Head of research department for Creativity & Society at the InnoRenew CoE, an architect and authorized designer architect. She was in charge of planning and implementing the new buildings of the research institute InnoRenew CoE. In addition, she is leading the design of the renovation of the Servite Monastery in Koper, as well as other projects for timber buildings and interiors. Her research interests include LCA and LCC analysis in architecture, REED design, design of spaces for childcare and education, and various aspects of building physics in timber construction.

She finished her education in the field of architecture at the Technical University in Vienna and at the Academy of Fine arts in 2002. In 2006 she finished her master studies at the Faculty of Architecture, University of Ljubljana.

Assoc. Prof. Jakub Sandak, PhD

Jakub Sandak is the InnoRenew CoE Deputy director and Head of research department for advanced manufacturing. He has a Doctor of Philosophy in Agricultural Sciences from Tottori University (Japan), a master of Science in Natural Resources Process Engineering from Shimane University (Japan), an engineer of Wood Science and Technology from University of Life Sciences in Poznan (Poland). He is a third generation carpenter. He is associate professor and research associate at the Faculty of Mathematics, Natural Science and Information Technology at University of Primorska. Jakub is an active member of several COST actions, including E35, E40, FP0904, FP1006, FP1101, FP1303, FP1407. He is a part of the International Wood Machining Seminar International Advisory Committee, and member of Editorial Boards for Drvna Industrija, as well as European Journal of Wood and Wood Products.

Assoc. Prof. Anna Sandak, PhD

Anna Sandak is the InnoRenew CoE Deputy director and Head of research department for materials. She is associate professor and research associate at the Faculty of Mathematics, Natural Science and Information Technology at University of Primorska. She was previously employed at Trees and Timber Institute of Italian National Research Council, where she coordinated the Laboratory of Surface Characterization. She has PhD in Wood Science and M.Sc. in Biology. Anna is a member of Italian Society for Near Infrared Spectroscopy, International Committee for Near Infrared Spectroscopy, International Research Group on Wood Protection, and International Society for Plant Spectroscopy. In 2022 Anna was awarded the ERC consolidator grant for the project ARCHI-SKIN (101044468-ERC-2021-COG) to develop the novel concept of a bio-active living coating system, pushing the boundaries of traditional materials toward the development of engineered living materials. In 2024, she secured the EIC Pathfinder Open grant for the REMEDY project (#101185862), which focuses on developing probiotic architectural inks and a novel biofabrication process for customizable and functional architectural surfaces.

Assist. Prof. Mohammad Derikvand, PhD

Mohammad Derikvand is a researcher from the timber engineering field in the InnoRenew CoE's Buildings research department. He also holds a position as assistant professor of the Built Environment at the University of Primorska. Mohammad studied Natural Resources Engineering with specialty in Wood Technology and Engineering in Iran. In 2016, he received a full scholarship form the Australian Research Council to pursue his PhD at the University of Tasmania (UTas). His PhD research at UTas investigated new ways in which high-value laminated timber products can be developed from Australian plantation pulpwood eucalyptus. During his stay in Tasmania, he also participated in several projects led

by the Centre for Sustainable Architecture with Wood (CSAW) aiming to develop engineered wood products from low-grade plantation timber. After completing his PhD, Mohammad moved to Finland and started working as a postdoc researcher in Timber Engineering at Aalto University. During his time at Aalto University, he dedicated his research to enhancing the circularity of timber products and structural systems. This included developing mass laminated timber floor systems from salvaged wooden materials and design for deconstruction of hybrid timber-concrete composite connections and structural elements.

Assoc. Prof. Michael Burnard, PhD

Michael Burnard is the InnoRenew CoE Deputy director and Head of research department for health. He is associate professor and research associate at the Faculty of Mathematics, Natural Science and Information Technology at University of Primorska. He grew up in the forest sector, first following his father and grandfather around the family sawmill and later working for the company, which became noted for its innovative products, marketing, and operations. He returned to academia in 2010 and completed a Master's of Science degree in Wood Science at Oregon State University in 2012. In 2013, he came to Slovenia to pursue a PhD at the University of Primorska. He is vice president of international association InnovaWood. From 2022 to 2024 he was professor of practice in sustainable wood construction and healthy living environments, Faculty of Agriculture and Forestry, University of Helsinki, Finland.

2. Workshop details

The workshop was hosted by University of Primorska at InnoRenew CoE. Participants learned about the New European Bauhaus Academy Pioneer Hub for Sustainable Built Environments with Renewable Materials (NEBAP Hub). The responsible architect for designing the biggest wooden building in Slovenia shared specific on timber building design. Participants learned about the details important for designing with timber, as well as about innovative sustainable building design concept Restorative Environmental and Ergonomic Design (REED). Furthermore, details on importance on monitoring of timber buildings during service life was presented in detail, including the software solution of data collections and analysis developed by InnoRenew CoE that is also used at the InnoRenew CoE building. Furthermore, the participants learned about wooden facades, their esthetical changes and design solutions. Furthermore, innovative coating systems made of engineered living materials for building facades under development at InnoRenew CoE were presented to participants. Additionally, participants learned about the

engineered wood products used in constructions. Details on the production, properties and certification systems in place were shared.
The workshop included also the tour of the InnoRenew CoE building and state-of-the-art research laboratories, where they learned about different research projects related to the topics that the workshop focused on.
Bellow we are providing a summary of topics the lectures covered.

Specific of designing timber buildings

Participants learned about designing timber building on example of constructing the biggest wooden building in Slovenia, InnoRenew CoE's building. The building complex houses offices, presentation rooms, laboratories and workshops for scientific research. The total gross floor area of the buildings is 8,200 m2 and includes eight research laboratories where timber research is carried out on both microscopic and macroscopic scales. In addition, the outdoor areas and the flat green roofs (1,400 m2 in total) provide open spaces for outdoor research activities, such as the testing of different wooden facades and small buildings exposed to weather. Buildings are a hybrid combination of wood, concrete and steel; while the foundations, basement and ground floor are concrete, the floors are composed entirely of wooden elements, with the exception of a concrete lift shaft and fire staircase in the north-east corner of the main building. Participants learned also about Restorative environmental and ergonomic design (REED) applied in the InnoRenew CoE's building. A restorative design system REED is emphasising the use of natural materials and is creating ergonomic, accessible, adaptable, and sustainable buildings. It has positive impacts on human health and wellbeing, and on the restoration of nature and coherent coexistence of people with the environment and the society.

Moisture control during service life

Despite all these critical advantages, many renewable materials, especially wood, are from its nature hygroscopic. Consequently, they absorb and release moisture depending on the relative humidity and temperature of their immediate environmental conditions. Unfortunately, moisturized biomaterials may become susceptible to fungal attacks and consequently to decay. Such fungal degradation highly affects the structural integrity and overall technical performance of the building. The modern construction technologies allow raising complex structures made of hygroscopic materials that can last long with perfect service performance. However, it can be guaranteed only when ensuring that no moisture crosses originally defined water barriers. In real-World cases, it is not possible to predict all wetting events that can be associated with structural/design imperfections, long lasting condensation or accidental floodings, among many other potential circumstances. Therefore, a dedicated, affordable and comprehensive solution for correct designing, execution and monitoring of buildings made from hygroscopic

materials may revolutionize the construction industry of today. The participants learned about such a solution including all necessary tools to be directly adopted by future users during sustainable structure designing, pre-fabrication, erecting, as well as along its daily operation and beyond

Wooden facades

Examples of bio-based materials' application in building facades were introduced. A state-of-the-art review, the latest trends in material selection, assembling systems, and innovative functions of facades were discussed. Selected case studies on buildings from diverse locations were subsequently presented to demonstrate the successful implementation of various biomaterial solutions, which defines unique architectural styles and building functions. The structures, morphologies and aesthetic impressions related to bio-based building facades were discussed from the perspective of art and innovation; essential factors influencing the performance of materials with respect to functionality and safety were also presented. Furthermore, innovative solutions with engineered living materials that are under development were presented.

Engineered wood products for construction

State-of-the-art engineered wood products such as cross-laminated timber (CLT), glued-laminated timber (GLT), laminated veneer lumber (LVL), nail laminated timber (NLT) and plywood that are widely implemented in modern wood constructions were presented. There application in different types of timber construction, including timber frame, mass timber, and hybrid construction were discussed.

Tour of the laboratories and building

Participants were guided through research laboratories where latest research directions were presented to them. They toured the following laboratories:

- Human Health Laboratory is designed to assess human well-being and performance under different indoor environmental conditions;
- Composites Laboratory which houses equipment for the preparation of bio-based composite materials;
- Physical Testing Laboratory that can assess the static, dynamic, and creep behavior of elastic, plastic, and viscoelastic materials as well as perform in situ testing of the built environment;
- Characterization Laboratory offers morphological, physicochemical, and rheological characterization of bio-based materials;
- Microscopy Laboratory has microscopes and sample preparation devices to analyze a range of materials at micro- and nanoscale;

- Acoustic Laboratory, fully equipped to perform research in architectural and building acoustics, noise control, structural dynamics, and vibrations;
- Advanced Manufacturing laboratory is a technological hub providing scientific support for a broad range of bio-based businesses as they adapt to Industry 4.0 and beyond;
- Engineered Living Materials Laboratory implements biomimetic principles for the development of new materials and modification processes;
- Workshop and Machine Shop is a service provider for other laboratories, enabling in-house preparation, conditioning, and storage of experimental samples and prototypes.

Figure 3: Lab tour at InnoRenew CoE – Composites laboratory

Figure 4: Lab tour at InnoRenew CoE – Characterization laboratory

The Study visit included also visit of Stilles CLT production, where the manager of the CLT production facility with support of Jakub Sandak and Mohammad Derikvand demonstrated the production steps. The participants had unique opportunity to learn about the CLT production with demonstration of all main phases:

- Inspection of individual boards prior going into production
- Finger jointing of lamellas
- Planning of lamellas
- Assembly of the board prior pressing
- Pressing of CLT board

The Study visit enabled unique access to latest developments of the sector with material that is under intellectual property rights of the lecturers that agreed to share the material at the Study visit, while it is not possible the material would be made openly accessible.

2.1 Participants

The workshop was attended by 41 participants (25 selected participants that successfully completed all three webinars of University of Primorska and 16 Life BEWoodEN project partners). Among selected participants were 10 architects, 2 engineers, 2 designers, 3 other professionals, and 8 students.

Figure 5: Group photo of the Study visit participants at InnoRenew CoE

Figure 6: Group photo of the Study visit participants at Stilles d.o.o.

2.2 Participants' feedback

After the Study visit participants were asked to provide their feedback about the quality of the organization and content. Questions we asked were:

- How did you find out about the event?
- What is your overall degree of satisfaction with the event?
- What is your degree of satisfaction with the overall event organization?
- Do you think the program of the event was well structured and complete?
- How do you rate the quality of the presented contents?
- How do you rate the quality of the speakers?
- Which sessions did you find most relevant?
- Do you have any general comments on the event?

We collected 24 responses, and in general positive feedback with the overall event, organization and program was received. Most participants learned about the event through universities (especially the University of Genoa), partner organizations, social media, professional associations, newsletters, and webinars. Participants found all the sessions valuable. They highlighted the topics related to engineered wood products, building design, and moisture control. Additionally, they appreciated the presentation of InnoRenew CoE building, laboratories and Stilles visit. At the end of the survey, participants could provide additional comments or suggestions regarding the event. Specifically, they proposed to include in future such events more practical and hands-on approach, and more dedicated time for sessions.

Participants that attended the study visit also received certificate of attendance (Figure 7).

Figure 7: Example of the Certificate of attendance.

3. TABLES FIGURES

Co-funded by the European Union

New European Bauhaus
beautiful | sustainable | together

Co-funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them.

Partners

Università di Genova | DAD DIPARTIMENTO ARCHITETTURA E DESIGN

REGIONE LIGURIA

ART-ER ATTRATTIVITÀ RICERCA TERRITORIO

UNIVERSITÀ DEGLI STUDI FIRENZE
DAGRI DIPARTIMENTO DI SCIENZE E TECNOLOGIE AGRARIE, ALIMENTARI, AMBIENTALI E FORESTALI

FLA FEDERLEGNOARREDO

HOUSING EUROPE

UNIVERZA NA PRIMORSKEM

Politechnika Wrocławska